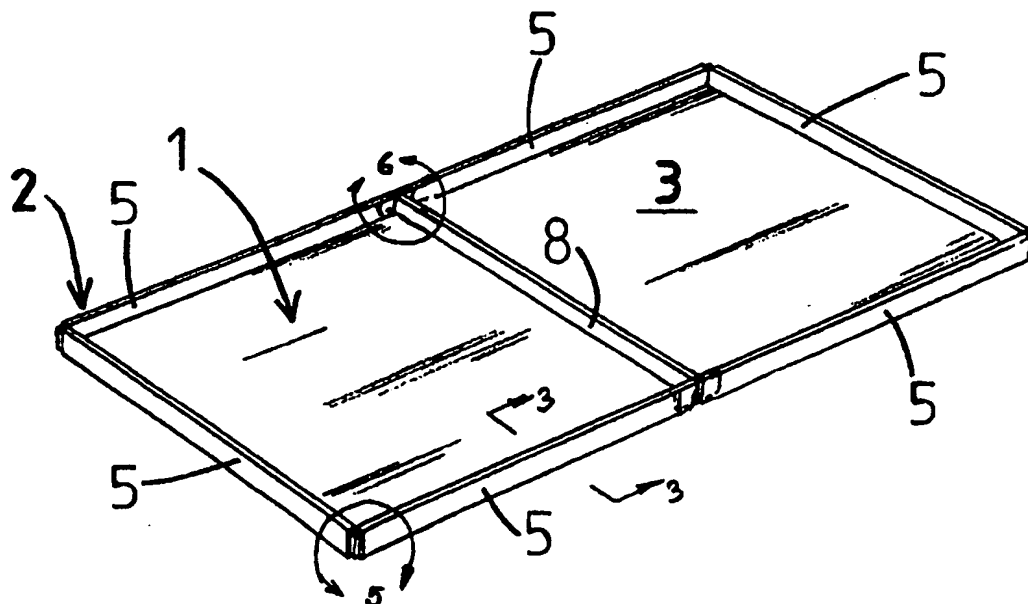




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : E04B 9/04, E04C 2/38, E04F 13/08	A1	(11) International Publication Number: WO 99/43907 (43) International Publication Date: 2 September 1999 (02.09.99)
(21) International Application Number: PCT/AU99/00109 (22) International Filing Date: 24 February 1999 (24.02.99) (30) Priority Data: PP 2006 24 February 1998 (24.02.98) AU (71)(72) Applicants and Inventors: ANDERSON, Anthony, John, Luke [AU/AU]; 8 Arkindale Place, Frankston, VIC 3199 (AU). REYNOLDS, Milton, Charles [AU/AU]; 18 Nangathan Way, North Croydon, VIC 3136 (AU). (74) Agents: OBERIN, Colin, James et al.; Oberins Arthur Robinson & Hedderwicks, 530 Collins Street, Melbourne, VIC 3000 (AU).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>

(54) Title: IMPROVEMENTS IN OR RELATING TO DECORATIVE PANELS



(57) Abstract

A method for producing a decorative panel (1) incorporating a sheet (3) of resiliently deformable material is disclosed. The method includes the steps of stretching the sheet (3) so as to pre-tension the sheet (3) prior to fixing the sheet (3) to the frame (2) of the decorative panel (1), fixing the frame (2) to the sheet (3), and trimming any sheet material beyond the perimeter (5) of the frame (2) following fixing. A decorative panel (1) having a frame (2) and incorporating a sheet (3) of resiliently deformable material, and a method for applying an image to a decorative panel (1), are also disclosed.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon	KR	Republic of Korea	PL	Poland		
CN	China	KZ	Kazakhstan	PT	Portugal		
CU	Cuba	LC	Saint Lucia	RO	Romania		
CZ	Czech Republic	LI	Liechtenstein	RU	Russian Federation		
DE	Germany	LK	Sri Lanka	SD	Sudan		
DK	Denmark	LR	Liberia	SE	Sweden		
EE	Estonia			SG	Singapore		

TITLE

Improvements in or relating to decorative panels.

FIELD OF INVENTION

5 The present invention relates to improvements in or relating to decorative panels and in one particular embodiment relates generally to ceiling tiles and to methods of applying images thereon.

BACKGROUND OF INVENTION

There are many known methods of forming a ceiling. One method in common use is to make ceiling tiles of standard dimension and instal them in tracks to form a suspended ceiling.

10 Ceiling tiles are typically made of a solid material including compressed materials and often are relatively heavy and inflexible. Such prior art tiles are generally available in a very limited range of surface textures and colours and typically are unsuited to being back-lit for diffuse illumination and are prone to damage.

15 The concept of a stretch ceiling is also known. One form of stretch ceiling is described in Australian Patent Application No 35397/89. In this arrangement a suitable material, such as BARRISOL® PVC sheet, is stretched between wall mounted rails to form a ceiling. The sheet is attached to an edging comprising a form of hook which is then hooked over a complementary portion of rail to support the sheet and maintain the desired stretch in the sheet. Since sheet material suitable for use in this arrangement may be prepared with a large number of different
20 colours and finishes, some of which may be back-lit, the stretch ceiling system is highly versatile.

However, such stretch ceilings are produced individually to meet the dimensions of each particular ceiling. Such stretch ceilings are accordingly less versatile than ceiling tiles in that it is not practicable to replace a portion of a ceiling, for example, for aesthetic purposes or to repair a damaged ceiling section.

25 To form an image on a prior art stretch ceiling of the type described, the sheet needs to be printed before being installed. However, installing a ceiling by stretching the material after printing can lead to distortion of the image. Moreover, it is not practicable to replace any distorted portion without replacing the whole ceiling. Although a portion of a ceiling comprising ceiling tiles can be readily removed and replaced, it has not hitherto been practical to prepare ceiling tiles from
30 stretch ceiling sheet material.

2.

readily removed and replaced, it has not hitherto been practical to prepare ceiling tiles from stretch ceiling sheet material.

SUMMARY OF INVENTION

5

The present invention accordingly provides, in one embodiment, a method for producing a decorative panel incorporating a sheet of resiliently deformable material.

10 In one aspect of this embodiment, the invention provides a method for producing a decorative panel having a frame and incorporating a sheet of resiliently deformable material, the method including the steps of

stretching the sheet so as to pre-tension the sheet prior to fixing the sheet to the frame,

15 fixing the sheet to the frame, and

trimming any sheet material beyond the perimeter of the frame following the fixing,

whereby to produce a decorative panel.

20 The present invention provides, in another embodiment, a decorative panel incorporating a sheet of resiliently deformable material.

In one aspect of this embodiment, the invention provides a decorative panel including

25 a frame,

a sheet of resiliently deformable material, and

fixing means for fixing said sheet to the frame,

the arrangement being such that the sheet is in a state of tension when fixed to said frame by the fixing means, the frame remaining substantially undeformed whereby to hold the sheet under tension.

30

The present invention provides, in a further embodiment, a method for applying an image to a decorative panel incorporating a sheet of resiliently deformable material.

35

3.

In one aspect of this embodiment, the invention provides a method for screen printing an image onto the surface of a decorative panel according to the invention, the method including the steps of

- 5 mounting the panel on a base for the screen printing, the arrangement being such that following the mounting substantially no relative movement between the panel and the base is possible and wherein at least part of the sheet is supported by the base,
mounting a screen for screen printing on the panel, and
screen printing an image onto the sheet.

10

These and other embodiments of the present invention are now further described.

- A decorative panel according to the present invention may be used for a variety of applications including the formation of ceilings, walls, dividers, fronts for light
15 boxes and other decorative and/or architectural features.

- In one particularly preferred embodiment a decorative panel according to the present invention comprises a ceiling tile. It is convenient to further describe the invention in relation to this particularly preferred embodiment. It is to be
20 appreciated however that the present invention may be advantageously applied to other forms of decorative panel and the scope of the invention is not to be restricted to ceiling tiles.

- A ceiling tile according to the present invention includes a frame, a sheet of
25 resiliently deformable material and fixing means for fixing the material to the frame.

- A frame according to the present invention may be of any suitable shape. Preferably the frame perimeter is in the form of a regular shape. Regular shapes
30 preferred for use in accordance with the present invention include squares, rectangles and other polygons. The perimeter of a frame may be curved. In one preferred arrangement the perimeter of a frame according to the present invention comprises a substantially regular rectangle in which at least a portion of one or more sides is curved.

35

A frame according to the present invention may be constructed from one or more frame elements. Frame elements, according to the present invention, include

4.

perimeter elements, for extending about the perimeter of the frame, joining elements for joining one or more frame elements and optionally auxiliary elements. Auxiliary elements may be adapted for strengthening the frame, carrying other features such as light fittings and other applications.

5

A perimeter element, according to the present invention, may be formed from any suitably shaped material. The element may be of constant cross-section. The element may have variable cross-section. The element may be tubular. It may be solid. Preferably a perimeter element comprises an elongated member. A light weight material such as an aluminium, plastics or alloy tubing of square or rectangular cross-section is preferred for use as a perimeter element. Aluminium alloy tubing of a substantially rectangular cross-section is particularly preferred.

10

Any element adapted for joining one or more perimeter elements may be used as a joining element according to the present invention. Joining elements of plastics or metal alloy are already known in the art. Preferred joining elements have an external profile complementary to the internal profile of a perimeter element whereby to form a friction fit therein. The internal profile of the perimeter member may be ribbed or otherwise adapted to facilitate the friction fit of the joining member.

15

20

Joining elements, according to the invention, may be adapted to form joins with other frame elements which comprise an in-line, angled, corner, T-junction or other form of junction between frame elements.

25

A joining element may join a frame element to the same frame element or to another frame element. In a preferred embodiment the frame elements are tubular and the joining elements are solid. In this embodiment the joining elements may be push fitted into the frame elements.

30

An auxiliary element may extend between one or more frame elements. An auxiliary element may extend between two or more parts of the same frame element. An auxiliary element may extend between parts of a frame element and between one frame element and another frame element. For example and without limitation, the frame may include an auxiliary element that extends between a perimeter element and one or more other perimeter elements, between one auxiliary element and one or more other auxiliary elements, between a perimeter

35

5.

element and another auxiliary element, between two or more parts of a perimeter element or between two or more parts of another auxiliary element.

5 An auxiliary element may be made from one or more components and typically is formed from materials the same as, or compatible with, those of other frame elements.

10 A frame according to the present invention should be formed so as to be capable of carrying the sheet material under tension without significant deformation of the frame. With a rectangular frame one or more auxiliary elements may act as strengthening ribs or spreaders. Such elements may, for example, extend across the frame from one long perimeter side to the other whereby to resist inward bowing or other deformation of the perimeter elements.

15 Auxiliary elements, according to the invention, may act as support members, mounting members for light fittings, mounting members for smoke alarms, apertures for fire sprinklers and may serve a variety of other functions as can be appreciated by those skilled in the art. Such an auxiliary element may provide a perimeter for any desired opening in a ceiling tile. An auxiliary element may
20 include a member for mounting any desired fitting on a ceiling tile with or without an opening in the ceiling tile.

In one preferred embodiment of the present invention, the perimeter of a ceiling tile is provided by a single perimeter element, joined to itself with one joining
25 element. The perimeter element is tubular with rectangular cross-section. Bends in the tube are facilitated by forming a bevel in three sides of the rectangular tube to allow the formation of a mitre-joint. The joining element in this embodiment may be a solid member which may be push fitted into either end of the tube, comprising the perimeter element whereby to form an endless perimeter for a
30 frame according to the present invention.

A sheet according to the present invention may comprise any resilient material suitable for mounting on the frame under tension. The material should have a memory whereby the material reverts to essentially its original shape upon release
35 of tension.

6.

5 A sheet according to the present invention may comprise a membrane consisting of one or more layers. At least one layer of the sheet acts as a tension layer which is capable of remaining in a state of tension for an extended period of time without undergoing significant stretching, creep or other tension reducing process. The extended period of time is preferably at least equal to the anticipated life of the panel.

10 A sheet for use in accordance with the invention is preferably less than 1.0 mm thick. Most preferably, the sheet is between 0.10 mm and 0.50 mm thick.

The tension layer is preferably capable of remaining in a state of tension in any direction substantially tangential to the sheet.

15 In a preferred embodiment of the present invention the tension layer comprises a PVC sheet exhibiting the abovementioned properties. The sheet may be a PVC copolymer and may include levels of plasticizer, flame retardants, colorants and other additives to provide the desired properties. The degree of cross-linking, axial orientation, surface finishing and/or other aspects of the sheet material may be varied consistent with the desired properties of the sheet material.

20 The sheet material may be apertured, embossed or otherwise treated as known in the art.

25 The sheet material used in accordance with the present invention should retain its characteristics of resilient deformability across the temperature range experienced at the intended installation.

30 One such sheet material which has been found suitable for use in accordance with the present invention is marketed as BARRISOL® sheet.

35 Fixing means used in accordance with the present invention may include any suitable means for fixing a sheet according to the present invention to a frame according to the present invention to form a decorative panel. The fixing means may comprise an adhesive. The fixing means preferably includes an epoxy based adhesive. It has been found that the adhesive marketed as ARALDITE® 2021 (XD4661 A/B) is particularly effective when used to fix BARRISOL® sheet to an aluminium frame.

7.

A ceiling tile according to the present invention is constructed such that the sheet is in a state of tension when fixed to the frame by the fixing means, the frame remaining substantially undeformed whereby to hold the sheet under tension.

5 In one particularly preferred embodiment the frame is substantially rectangular. In this arrangement the frame includes at least one auxiliary element for the purpose of providing extra support in resisting the forces exerted on the frame by the sheet so that the frame remains substantially undeformed under the influence of the said forces. In this embodiment, the auxiliary element is in the form of a rod which
10 extends between the long perimeter sides of the frame, parallel to the short perimeter sides. In this embodiment, the auxiliary element may be made slightly longer than the span between the long sides so that the rod may be slightly bowed when fitted to the frame. In this way, the auxiliary element may exert an outwardly directed force on the long perimeter sides of the frame to assist in the
15 resistance of the inwardly directed tensile forces exerted by the sheet on the long perimeter sides of the frame. In this embodiment, this auxiliary element is not fixed to the sheet.

The present invention also provides a method for forming a ceiling tile. One such
20 method, according to the present invention, includes a stretching step, a fixing step and a trimming step. To perform such method a frame is required preferably a frame as described herein.

In the stretching step according to the present invention, a piece of sheet material
25 as described herein is stretched so that it may be pre-tensioned prior to being fixed to the frame. Preferably, the piece of sheet material is stretched in two directions tangential to the plane of the sheet.

The piece of sheet material may be stretched by anchoring a first part of the piece
30 of sheet material and stretching another part of the piece of sheet material. The piece of sheet material may be stretched by pulling different parts of the piece of sheet material in different directions substantially planar with respect to the sheet. In one embodiment of the present invention, the piece of sheet material is substantially rectangular and is stretched over a base. In this embodiment, two
35 opposite sides of the piece of sheet material are first anchored to the base. The two anchored sides are then moved apart relative to one another to stretch the piece of sheet material in a first direction. The other two sides of the piece of sheet

8.

material are then moved apart relative to one another to stretch the piece of sheet material in a second direction. The piece of sheet material may be stretched to the appropriate extent in this manner.

- 5 As will be appreciated by the skilled reader, the sheet may be stretched simultaneously in two directions at right angles to one another but each substantially within the plane of the sheet to secure the desired degree of tension of the material.
- 10 Once the piece of sheet material has been stretched in the stretching step, one or more frames may be fixed to the piece of sheet material in a fixing step according to the present invention. Preferably, a plurality of panels is formed from a single piece of stretched material. It has been found that at least five and preferably at least seven standard sized (600 × 1200mm) ceiling tiles can be formed from a
- 15 single pre-tensioned sheet of resiliently deformable material in the method provided herein.

In the fixing step according to the present invention, the fixing means is applied, introduced, activated or effected as the case may be in order to fix the piece of

20 sheet material to the frame to form a ceiling tile. In the case where the fixing means is an adhesive, the adhesive, or parts of the adhesive as appropriate, are applied to the frame and/or the piece of sheet material as required in order to effect the fixation of the sheet to the frame.

- 25 In the preferred embodiment, where the frame is aluminium alloy, the sheet material is BARRISOL® and the fixing means is the adhesive ARALDITE® 2021 (XD4661 A/B), the adhesive may be advantageously mixed, then applied to the perimeter elements of the frame. Adhesive is optionally applied to any auxiliary elements. It is to be appreciated that no adhesive should
- 30 be applied to any auxiliary elements which may require subsequent removal from the perimeter elements of the frame. The frame is then mounted on the stretched piece of sheet material such that the fixing means is positioned to fix the pre-tensioned sheet material to at least the perimeter elements of the frame. In this embodiment, the frame and tensioned material are left in the same position for
- 35 approximately seven minutes to allow the adhesive to set.

9.

After the fixing step, a trimming step may be performed. In the trimming step, any sheet material beyond the perimeter of the frame may be cut away from the frame to produce a decorative tile comprising a frame with the sheet material adhered thereto under tension. The degree of tension is preferably such that in its relaxed state the sheet material would be 5-15% smaller and preferably 7-10% smaller than the frame.

According to another embodiment of the present invention there is provided a method for modifying the shape of a ceiling tile according to the present invention without substantially reducing the tension in the sheet. The shape may be modified by changing the shape of the perimeter of the ceiling tile. The shape may be modified by suitably constructing an opening in the ceiling tile. The shape may be modified by dividing one ceiling tile into two or more tiles.

Modification of the shape of a ceiling tile according to the present invention may be effected using an appropriately shaped auxiliary element. For example, where the shape of the perimeter of the ceiling tile is to be changed, the new perimeter shape may be defined by an auxiliary element. For convenience, such an appropriately shaped auxiliary element is referred to herein as a shaped auxiliary element.

A shape modification method according to the present invention for modifying the shape of a ceiling tile according to the present invention may include a joining step, a supplementary fixing step, a frame cutting step and a sheet trimming step.

A joining step according to the present invention may utilise any suitable means for joining a shaped auxiliary element to one or more frame elements as required. Preferred means for joining a shaped auxiliary element to a frame element includes, without limitation, riveting, bolting and adhering. Other means of joining including the use of joining elements as described herein are also envisaged within the scope of the present invention.

In a supplementary fixing step according to the present invention, the shaped auxiliary element is fixed to the sheet. Any suitable means for fixing the shaped auxiliary element to the sheet may be used. The supplementary fixing step may be carried out in the same manner as the fixing step according to the present invention. In one preferred embodiment the shaped auxiliary element is fixed to

10.

the sheet using an adhesive. As will be appreciated by the skilled reader, the supplementary fixing step may be conveniently carried out at the same time as the fixing step described herein.

- 5 In a frame cutting step according to the present invention, part of the frame may be removed if desired. In one embodiment a frame cutting step is employed after joining a shaped auxiliary element to the frame and after a supplementary fixing step. In a preferred embodiment, a frame cutting step is employed when the shape of the boundary of a ceiling tile is to be modified. Any suitable method of
10 removal may be used. In one embodiment a hacksaw is used to cut away the undesired part of the frame.

In a sheet trimming step according to the present invention, part of the sheet may be removed as desired.

15

In one embodiment, the shape modification method is employed to make an opening in the ceiling tile for a light, fire sprinkler or other fitting. In this embodiment the frame is rectangular. A shaped auxiliary element defining the boundary for the intended opening is first joined to two opposite sides of the frame
20 in a joining step. Part of the shaped auxiliary element defining the boundary for the intended opening is fixed to the sheet in a supplementary fixing step. The appropriate part of the sheet is then removed in a trimming step to produce the opening in the ceiling tile as desired.

- 25 In yet another preferred embodiment suitable for producing a tile of irregular shape, a rectangular frame is prepared. A shaped auxiliary element is formed to a desired modified shape, for example, to fit around a pillar or other obstruction. The shaped auxiliary element is affixed to the perimeter elements in the desired location. The perimeter elements and shaped auxiliary element are fixed to the
30 pre-tensioned sheet. The undesired portion of the perimeter of the frame may be removed before or after the fixing step. After removal the shaped auxiliary element becomes part of the perimeter of the re-shaped tile and the trimming step may be completed about the newly formed perimeter.

- 35 The present invention further provides a method for screen printing an image onto a surface of a ceiling tile according to the present invention.

11.

A method according to the present invention for screen printing an image onto the surface of a ceiling tile according to the present invention includes a mounting step, a screen application step and a screen printing step.

5 In the mounting step according to the present invention, a ceiling tile according to the present invention is mounted on a base for screen printing. Preferably, the shape of the ceiling tile and the shape of the base are such that after the ceiling tile is mounted on the base substantially no relative movement between the ceiling tile and the base is possible. Absence or substantial absence of relative movement
10 between the ceiling tile and the base allows the accurate positioning of the frame with respect to the base and the screen for screen printing so that a screen printed image may be accurately located on the ceiling tile.

15 At the conclusion of the mounting step, preferably at least part of the base is touching, or is located close to, the sheet or part of the sheet whereby to provide support for the sheet when the ceiling tile is being screen printed.

The method for screen printing an image onto the surface of a ceiling tile may include an auxiliary element removal step in which one, some or all auxiliary
20 elements are temporarily removed from the frame whereby to reduce the frame to its peripheral elements for support and free more of the sheet for support by the base. In this arrangement the base may provide support resisting the deformation of the peripheral elements and hence the material which may result in image distortion after re-assembly of the frame.

25 To facilitate screen printing, irregular shaped tiles may be initially produced as rectangular tiles and after printing modified by using a shaped auxiliary element and removing undesired pieces of peripheral frame and sheet material as described herein.

30 In the screen application step according to the present invention, a screen for screen printing is mounted on the ceiling tile. Preferably, the screen is accurately located with respect to the base so that the screen can be accurately located with respect to the ceiling tile.

35 A stencil is mounted on the screen prior to the screen printing step. The stencil may be mounted on the screen before or after the screen application step.

12.

In this specification the word dye is used to refer to any material suitable for producing an image when applied to a surface. A reference to dye includes without limitation a reference to any suitable dye, paint, ink or other material for producing an image. Dye as referred to herein may include one colour or more than one colour.

In the screen printing step according to the present invention, dye is screen printed onto the ceiling tile using the screen and the stencil in known manner.

The above method for screen printing an image onto a surface of a ceiling tile may be repeatedly applied to a ceiling tile to produce a screen printed image made up of more than one dye. In particular, the method may be applied twice to produce an image with two colours, three times to produce an image with three colours and so on. The possibility of locating the frame accurately with respect to a base for screen printing allows the ceiling tile to be placed on different screen printing bases for different colours without losing the ability to accurately locate each colour in the final image on the ceiling tile. This method overcomes many difficulties associated with screen printing onto a flexible sheet on different screen printing bases.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a perspective view from above of a ceiling tile according to one preferred embodiment of the invention;

Figure 2 is a perspective view from below of the tile of Figure 1;

Figure 3 is a cross-sectional view along the line 3-3 of Figure 1;

Figure 4 is a perspective view from above of a portion of the tile according to another preferred embodiment showing an alternative form of auxiliary element acting as a spreader;

Figure 5 is an enlarged exploded view of the region designated 5-5 in Figure 1;

13.

Figure 6 is an enlarged exploded and partly cut-away view of the region designated 6-6 in Figure 1;

5 Figure 7 is a perspective view from above of a tile according to another preferred embodiment which incorporates an auxiliary element for mounting a down-light; and

10 Figure 8 is a perspective view from above of a portion of tile showing the positioning of a shaped auxiliary element.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

15 The embodiment of Figures 1 and 2 shows a decorative panel in the form of a ceiling tile 1, including a frame 2 and a sheet 3 of resiliently deformable material. As best seen in Figure 3, sheet 3 is fixed to frame 2 by fixing means in the form of a layer of adhesive 4.

20 Frame 2 is substantially rectangular. Frame 2 is constructed from a plurality of perimeter elements 5. In the arrangement shown in Figure 1 and 2, adjacent perimeter elements 5 are formed from tubular sections of rectangular cross-section as best seen in Figure 3.

25 In the arrangement of Figure 1, perimeter elements 5 are joined at the corners by joining elements 6 in the form of a L shaped insert, shaped to form a friction fit when inserted into the tubular section forming the perimeter elements as shown in exploded section in Figure 5.

30 As best seen in Figure 6, the perimeter elements 5 forming each long side of the Figure 1 arrangement, each include a T-shaped joining element 7 which joins the perimeter elements together to form the long side of the perimeter frame and also joins auxiliary element 8 to the peripheral frame.

35 Auxiliary element 8 acts as a spreader to resist inward bowing of the long sides of the frame 2 and thereby facilitates frame 2 carrying sheet 3 under tension without deformation.

14.

In the arrangement of Figure 4, auxiliary element 9 also acts as a spreader. Auxiliary element 9 comprises a rod mounted through apertures in the inner wall of each of perimeter elements 5. Auxiliary element 9 is bowed slightly whereby to exert an outwardly directed force on the long perimeter sides of frame 2 to assist in the resistance of the inwardly directed tensile forces exerted by sheet 3. In this arrangement each long perimeter side of frame 2 comprises a single perimeter element 5 which may be joined at the corners by a joining element or by a mitred corner (not shown).

In the alternative arrangement shown in Figure 7, auxiliary element 10 comprises a pair of spaced apart spreaders 11, each adapted for attachment to perimeter members 5 by welding, adhesives, screw fasteners, rivets or other means via lugs 12. Spreaders 11 are spaced apart by spacers 13. Ring 14 is affixed to spreaders 11. Sheet material 3 may be adhered to the underside of ring 14 and the sheet material within ring 14 may be removed. This would allow a downlight, fire sprinkler, etc to be projected through the aperture so formed.

By not forming an aperture, ring 14 may act as a base for mounting a back light, smoke alarm, etc above the ceiling. As will be appreciated by those skilled in the art, ring 14 may be replaced by a member with a larger mounting surface, such as a disc or a block, to form a base.

Figure 8 illustrates the installation of shaped member 15 within perimeter members 5. This method can be used to form a curved concave corner to tile 1 by removing that portion of elements 5 and sheet 3 which project beyond shaped member 15 so that shaped member 15 forms part of the outer perimeter of tile 1.

It is to be appreciated that where auxiliary members 8, 9, 10 and 15 are not fixed to sheet 3 they may be removed to facilitate printing of the underside of sheet 3. The underside, namely the side visible in Figure 2 which would be the side visible from within a room when tile 1 is installed in a ceiling, may accordingly be printed with images such as decorative, informative or advertising images. Where appropriate, for example, in the case of shaped element 15 a supplementary fixing step followed by a sheet trimming step may be required to finalise preparation of a tile 1 of irregular shape having an image applied thereto.

15.

As those skilled in the art will appreciate, the present invention provides a stretch ceiling in the form of decorative panels such as tiles which may have an image applied thereto. Thus, the invention provides the advantages of a stretch ceiling with the flexibility of ceiling tiles which may have an image economically applied thereto. This combination was not hitherto available from known prior art materials.

Whilst it has been convenient to describe the invention herein in relation to particularly preferred embodiments, it is to be appreciated that other constructions and arrangements are considered as falling within the scope of the invention. Various modification, alterations, variations and/or additions to the constructions and arrangements described herein are also considered as falling within the scope and ambit of the present invention.

CLAIMS

1. A method for producing a decorative panel having a frame and incorporating a sheet of resiliently deformable material, the method including the steps of
- stretching said sheet so as to pre-tension said sheet prior to fixing said sheet to said frame,
- fixing said sheet to said frame, and
- trimming any sheet material beyond the perimeter of said frame following said fixing,
- whereby to produce a decorative panel.
2. A method according to claim 1, wherein said sheet is stretched in two directions tangential to the plane of said sheet.
3. A method according to claim 2, wherein said sheet is stretched substantially simultaneously in two directions at right angles to one another but each substantially within the plane of said sheet whereby to secure the desired degree of tension for said sheet.
4. A method according to claim 2, wherein said sheet is substantially rectangular and said sheet is stretched over a base, and wherein pairs of opposed sides of said sheet are anchored to said base, a first pair of said opposed sides is moved apart relative to one another to said sheet in a first direction, and a second pair of opposed sides is moved apart relative to one another in a second direction, whereby to stretch said sheet.
5. A method according to claim 1, wherein said sheet is fixed to said frame by adhesion.
6. A method according to claim 5, wherein said adhesive is applied to at least perimeter elements of said frame and/or to said sheet, and wherein said frame is mounted on said sheet such that said adhesive is positioned to fix said sheet to at least said perimeter elements of said frame.
7. A method according to claim 1, and further including the step of modifying the shape of said panel, wherein a shaped member is positioned within the perimeter of said frame and the portions of perimeter elements of said frame and said sheet which project beyond said shaped member are removed so that said shaped member forms part of the perimeter of said frame.
8. A method according to claim 1, and further including the step of mounting at least one auxiliary element on said frame whereby to provide support to said frame in resisting forces exerted on said frame by said sheet so that said

17.

frame remains substantially undeformed under the influence of said forces.

9. A method according to claim 8, wherein said auxiliary element comprises a pair of spaced apart spreaders attachable to the perimeter of said frame, and an apertured member is positioned between said spreaders, and wherein any sheet material within the space defined by said aperture is removed to allow for a fixture or for light to be projected through an aperture so formed in said sheet.

10. A method according to claim 8, wherein said auxiliary element acts as a base for mounting a fixture to said panel.

11. A method according to claim 1, wherein said sheet of resiliently deformable material is formed from BARRISOL® sheet material.

12. A method according to claim 11, wherein said decorative panel comprises a ceiling tile.

13. A method for producing a ceiling tile having a frame and incorporating a sheet of resiliently deformable BARRISOL® sheet material, the method including the steps of

stretching said sheet so as to pre-tension said sheet prior to fixing said sheet to said frame,

fixing said sheet to at least the perimeter of said frame by adhesion, and trimming any sheet material beyond the perimeter of said frame following said fixing,

whereby to produce ceiling tile.

14. A ceiling tile produced according to the method of claim 13.

15. A decorative panel including a frame,

a sheet of resiliently deformable material, and fixing means for fixing said sheet to said frame,

the arrangement being such that said sheet is in a state of tension when fixed to said frame by said fixing means, said frame remaining substantially undeformed whereby to hold said sheet under tension.

16. A decorative panel according to claim 15, wherein said sheet is pre-tensioned prior to fixing said sheet to said frame.

17. A decorative panel according to claim 15, wherein said sheet comprises a membrane having one or more layers, at least one of said layers being a tension layer capable of remaining in a state of tension relative to said frame for an extended period of time without undergoing significant stretching, creep or other tension reducing process.

18. A decorative panel according to claim 17, wherein said tension layer is

18.

capable of remaining in a state of tension in any direction substantially tangential to said sheet.

19. A decorative panel according to claim 18, wherein said tension layer comprises a PVC sheet.

5 20. A decorative panel according to claim 19, wherein said sheet is formed from BARRISOL® sheet material.

21. A decorative panel according to claim 15, wherein said frame comprises a plurality of tubular frame elements joined by one or more joining elements.

22. A decorative panel according to claim 15, wherein said fixing means
10 comprises an adhesive.

23. A decorative panel according to claim 22, wherein said adhesive comprises an epoxy based adhesive marketed as ARALDITE® 2021.

24. A decorative panel according to claim 15, wherein said frame includes at least one auxiliary element whereby to provide support to said frame in resisting
15 forces exerted on said frame by said sheet so that said frame remains substantially undeformed under the influence of said forces.

25. A decorative panel according to claim 24, wherein said auxiliary element comprises a rod extending between the long perimeter sides of said frame.

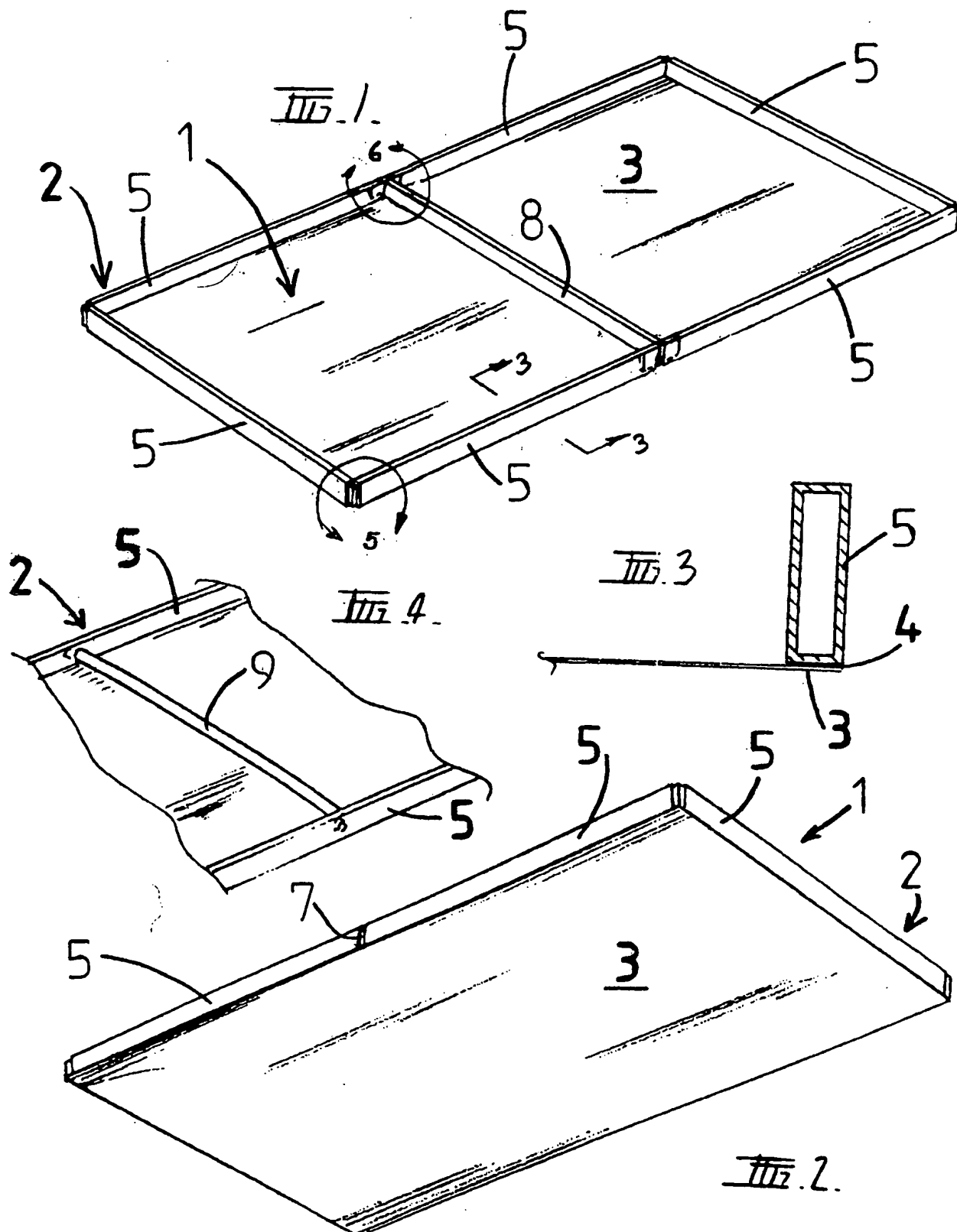
26. A decorative panel according to claim 24, wherein said auxiliary element
20 comprises a pair of spaced apart spreaders attachable to the perimeter of said frame, and an apertured member positioned between said spreaders, and wherein any sheet material within the space defined by said aperture is removed to allow for a fixture or for light to be projected through an aperture so formed in said sheet.

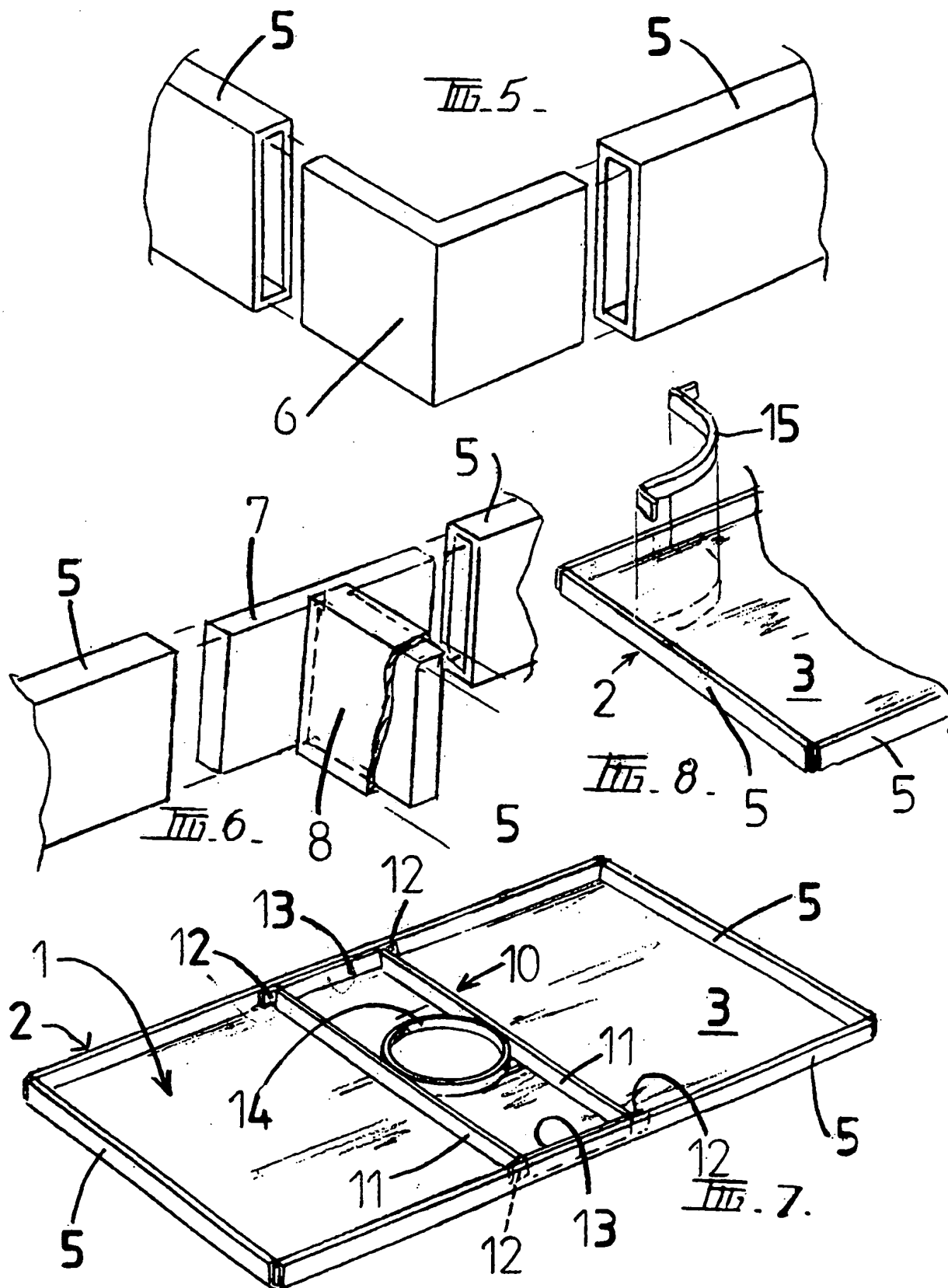
27. A decorative panel according to claim 24, wherein said auxiliary element
25 acts as a base for mounting a fixture to said panel.

28. A method for screen printing an image onto the surface of a decorative panel according to claim 15, the method including the steps of

30 mounting said panel on a base for said screen printing, the arrangement being such that following said mounting substantially no relative movement between said panel and said base is possible and wherein at least part of said sheet is supported by said base,
mounting a screen for said screen printing on said panel, and
screen printing an image onto said sheet.

35 29. A method according to claim 28, wherein said decorative panel comprises a ceiling tile.





INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00109

A. CLASSIFICATION OF SUBJECT MATTER																						
Int Cl ⁶ : E04B 9/04, E04C 2/38, E04F 13/08																						
According to International Patent Classification (IPC) or to both national classification and IPC																						
B. FIELDS SEARCHED																						
Minimum documentation searched (classification system followed by classification symbols)																						
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU: E04B 9/04, E04C 2/38, E04F 13/08																						
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) DERWENT, JAPIO: PANEL, WALL, TILE, CEILING, SHEET, FABRIC, CLOTH, MEMBRANE, COVER, STRETCH, TENS, FRAM, RESILIENT, ELASTIC, E04B/-, E04C/-, E04F/-																						
C. DOCUMENTS CONSIDERED TO BE RELEVANT																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
X	US 5129202 A (PAYNE et al) 14 July 1992 Figure 4	1-4, 11-20																				
X	US 5715638 A (ANDERSON) 10 February 1998 Figure 3. Column 3 line 55 to Column 4 line 44	1-6, 11-20, 22, 23																				
X	DT 2619634 A (EPPERLEIN) 17 November 1977 Figures 1-3	1-4, 13-20																				
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex																						
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A"</td> <td>document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T"</td> <td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E"</td> <td>earlier application or patent but published on or after the international filing date</td> <td>"X"</td> <td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L"</td> <td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y"</td> <td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O"</td> <td>document referring to an oral disclosure, use, exhibition or other means</td> <td>"&"</td> <td>document member of the same patent family</td> </tr> <tr> <td>"P"</td> <td>document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family	"P"	document published prior to the international filing date but later than the priority date claimed		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																			
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone																			
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																			
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family																			
"P"	document published prior to the international filing date but later than the priority date claimed																					
Date of the actual completion of the international search 23 April 1999		Date of mailing of the international search report -4 MAY 1999																				
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929		Authorized officer A. Hendrickson Telephone No.: (02) 6283 2415																				

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00109

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 83-726157/31, Class Q43, JP 58-107279 A (HITACHI KK) 25 June 1983 Abstract	1-4,13-21
X	US 4635410 A (CHUMBLEY) 13 January 1987 Figures 2-4	1-6,11-20
X	EP 215715 A (SCHERRER) 25 March 1987 Figures 2-4	1-4,11-20
X	EP 838564 A (LEINHOP PLANEN ZELTE TEXTILES BAUEN GmbH) 29 April 1998 Figure 1	1-4,13-20

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU 99/00109

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	5129202	CA	2019502	EP	443084	JP	3250149
		US	5174086				
EP	215715	CA	1315945	FR	2587392	JP	62118180
		US	4711060				
EP	838564	DE	29618340	DE	1964329		
END OF ANNEX							